Session 6
Dynamic Modeling and Systems Analysis

1:00 – 1:05p	Overview – Jeffrey Csank
1:05 – 1:30p	Dynamic Systems Analysis – Jeffrey Csank
1:30 – 1:55p	T-MATS (Toolbox for the Modeling and Analysis of Thermodynamic Systems) – Jeffryes Chapman
1:55 – 2:20p	Reducing Conservatism in Aircraft Engine Response Using Conditionally Active Min-Max Regulators – Ryan May

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Dynamic Systems Analysis

- Preliminary Engine Design
  - Systems Analysis (Steady state)
  - Lack of dynamic performance information
    - Historical data (past experiences)
    - Additional conservatism in the design
- Dynamic Systems Analysis
  - Better predict/account for dynamic operation in PED
  - Allow for trade-offs between performance and operability margins to meet future engine performance requirements
  - Enabled through the Tool for Turbine Engine Closed-loop Transient Analysis (TTECTrA)

T-MATS (Toolbox for the Modeling and Analysis of Thermodynamic Systems)

- Simulation System designed to give a user a library containing building blocks that may be used to create dynamic Thermodynamic systems. Includes:
  - Iterative Solving capability
  - Generic Thermodynamic Component models
    - Turbomachinery components (compressor, turbine, burner, nozzle, etc.)
  - Control system modeling (controller, actuator, sensor, etc.)
- MATLAB/Simulink Based
- Open Source (free of proprietary and export restrictions)
- Development of T-MATS is being led by NASA Glenn Research Center
  - NASA's focus for this project is on the modeling of aerospace applications, however the T-MATS framework is extremely general and can be applied to any thermodynamic model.

Reducing Conservatism in Aircraft Engine Response Using Conditionally Active Min-Max Limit Regulators

- Typical aircraft engine control is based on a Min-Max scheme
- Designed to keep the engine operating within prescribed mechanical and operational safety limits
  - Compares fuel flow to determine the limit that is closest to being violated
  - Conservative
- Improve engine performance by allowing the limit regulators to only be active when a limit is in danger of being violated.